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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/676,082	10/02/2003	Minoru Toriumi	025311-0122	7767

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EXAMINER	
HU, HENRY S	

ART UNIT	PAPER NUMBER
1713	

DATE MAILED: 09/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/676,082	TORIUMI, MINORU	
	Examiner	Art Unit	
	Henry S. Hu	1713	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *Amendment of August 16, 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *2-4,7,11 and 16-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *2-4,7,11 and 15-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. It is noted that this application 10/676,082 is **a DIV of 09/986,048 abandoned on March 19, 2004**. This Office Action is in response to **Amendment** filed on August 16, 2005. **Claims 2-4, 7, 11 and 15-20 were amended**, while no new claim was added. To be more specific, the Applicants have incorporated the missing limitation of the cancelled Claim 1 into parent Claim 15 for anti-reflective coating as pointed out in claim objection; dependent Claims **2-4, 7, 11 and 16-20** have been revised as so to clarify the subject matter accordingly. **Claims 2-4, 7, 11, and 15-20** are now pending with only one independent claim (Claim 15). In view of the key argument on "ArF-1 contains no fluorine at all" on page 5 of Remarks, all 102 and 103 rejections are withdrawn and are rewritten with combining other art from new search. An action follows.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. *The limitation of parent **Claim 15** of the present invention relates to **a method for manufacturing a semiconductor device, comprising**: (a) **forming an anti-reflective coating** by*

coating a composition ***over a semiconductor substrate****, the composition including: (i) a first polymer containing fluorine; and (ii) a solvent for dissolving said first polymer; (b)* ***forming a resist film of a polymer containing fluorine*** *on the anti-reflective coating; and (c)* ***radiating exposure light*** *onto the resist film.*

See other limitations of dependent ***Claims 2-4, 7, 11 and 16-20.***

4. Claims 2, 11 and 15-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Subramanion et al. (US 5,986,344).

Regarding the limitation of parent **Claim 15**, **Subramanion** et al. have disclosed a method to produce a semiconductor device by **coating a resist onto a layer of anti-reflective coating** to be useful for patterning (column 1, line 67 – column 2, line 1; column 1, line 6-11; also see light exposure on all figures). To be specific, **by coating a photoresist composition solution directly onto the top of an antireflective coated (ARC) bottom layer comprising FLARE 2.0™** (column 3, line 66-67), wherein **FLARE 2.0™ is a fluorinated poly(arylene ether) polymer (FPAE)** (column 3, line 34-59; column 7, line 27-31). With respect to the required limitation of "using a fluorinated resist", Subramanion may have implicitly disclosed using **a fluorinated resist** as top coating in order to be compatible with FLARE fluoropolymer ARC bottom coating (column 4, line 47-61). In a close examination, Subramanion may have suggested in the discussion for Fig. 3D by **using the same types of organic materials for both resist layer and ARC layer** in order to be not etched by fluorine-based gas etch (column 4, line 43-54).

5. Regarding **Claim 2**, FLARE is a fluorinated poly(arylene ether), and is a polymeric product made from condensation polymerization of two monomers such as Bis-phenol-A and biphenyl (at least one is fluorinated).

Regarding **Claims 11 and 16-18**, Subramanion may have taught all the process requirements mentioned in Claims 16-18 in order to prepare the bottom antireflective coated (ARC) layer from FLARE 2.0™. For instance, the process may involve spin coating FLARE fluoropolymer's solution onto a semiconductor substrate and then was baked to dry as known in the art (column 8, line 51-55). Nitrogen atmosphere drying is not disclosed as a required condition.

Regarding **Claim 19**, the thickness of ARC film after drying is kept at **6000 Angstroms** (column 7, line 9-11). Regarding **Claim 20**, Subramanion teaches that the wavelength of the exposure light or radiation on photoresist can be **248 nm** (column 7, line 7-9).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claims 2, 11 and 15-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Padmanaban et al. (US 6,365,322 B1) in view of Subramanion et al. (US 5,986,344).

Regarding the limitation of parent **Claim 15**, **Padmanaban** et al. disclose specifically a method to produce a semiconductor device by **coating a photoresist composition solution directly onto an antireflective coated (B.A.R.C.) silicon substrate**, wherein the bottom anti-reflective coating solution is from **ArF-1** by Clariant Corp., and the coated substrate can then be baked dry and then imagewise exposed to actinic radiation, x-ray, electron beam, ion beam or laser radiation (column 7, line 30 – column 8, line 67; for microlithography process see column 1, line 12-29). Padmanaban further discloses that such a photoresist material, particularly used at 157 nm, may be fluorinated and include **a fluorinated polymer** as long as it is optically transparent at that wavelength (column 2, line 15-33).

In a close examination on the key argument on "ArF-1 contains no fluorine at all" on page 5 of Remarks, Padmanaban is therefore silent about using **a fluorinated bottom**

antireflective coating. **Subramanion** et al. teach specifically a method to produce a semiconductor device by **coating a photoresist composition solution directly onto the top of an antireflective coated (ARC) layer such as FLARE 2.0™** (column 3, line 66-67; particularly see column 1, line 67 – column 2, line 1), wherein **FLARE 2.0™ is a polymer related to fluorinated poly(arylene ether)** (may be called FPAE) (column 3, line 34-59; column 7, line 27-31). By doing so, an advantage is to obtain a semiconductor device sensitive to radiation in the deep ultraviolet for patterning (column 1, line 6-11). It is noted that Subramanion may have implicitly disclosed using a fluorinated resist coating in order to be compatible with FLARE fluoropolymer ARC coating (column 4, line 47-61).

In light of the fact that the involved references are preparing the same or similar type of fluorinated film deposition or coating containing the same layered architect for photoresist application, one having ordinary skill in the art would therefore have found it obvious to modify Padmanaban's photoresist composition by using **a bottom antireflective fluorinated coating** such as **FLARE 2.0™** and the like fluoropolymer as taught by Subramanion. By this modification, one would still expect to obtain a photoresist semiconductor device sensitive to radiation in the deep ultraviolet for patterning based on functional equivalence and interchangeability. Additionally, by changing to a FLARE fluoropolymer ARC bottom coating, it is expected to be more compatible with a fluorinated resist top coating. Thereby a better and more diversified photoresist product can be obtained.

8. Regarding **Claims 16-19 and 2**, the bottom antireflective coated (B.A.R.C.) silicon substrate was prepared by spin coating **ArF-1** fluoropolymer's solution onto a silicon wafer substrate and then was baked at **200 °C for 60 sec** (column 8, line 51-55). Nitrogen atmosphere drying is not disclosed as a required condition. The thickness of BARC film after drying is kept at **82 nm** (column 8, line 55-56).

Regarding **Claim 20**, the wavelength of the exposure light or radiation on photoresist is in the range of **100-300 nm**, particularly at **248, 193 and 157 nm** (column 2, line 15-33).

Regarding **Claim 11**, the solvent used for the **non-crosslinked** fluorine-containing polymer in making antireflective coating would be different from those used for photoresist composition. Suitable solvent for photoresist composition may include propylene glycol mono-alkyl ether, xylene, amyl acetate and the like (column 7, line 5-10).

9. Claims 2, 11 and 15-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujie et al. (US 6,303,264 B1) in view of Subramanion et al. (US 5,986,344).

Regarding the limitation of parent **Claim 15**, **Fujie** et al. have disclosed a method to produce a semiconductor device by **coating a fluorinated photoresist composition solution onto a silicon wafer substrate**, and the coated substrate can be baked dry and then imagewise exposed to radiation through a mask (abstract, line 1-15; column 2, line 6- 47; for microlithography process see column 1, line 5-63). Fujie et al. further disclose that such

photoresists can be **a fluorinated polymer** as long as it is optically transparent at the desired wavelength (column 6, line 43-67; column 7, line 47-49).

Fujie is silent about first putting **a bottom antireflective coating for photoresist film. Subramanion** et al. teach specifically a method to produce a semiconductor device by **coating a photoresist composition solution directly onto the top of a bottom antireflective coated (ARC) layer such as FLARE 2.0™** (column 3, line 66-67; particularly see column 1, line 67 – column 2, line 1), wherein **FLARE 2.0™ is a fluorinated poly(arylene ether) polymer (FPAE)** (column 3, line 34-59; column 7, line 27-31). By doing so, an advantage is to obtain a semiconductor device sensitive to radiation in the deep ultraviolet for patterning (column 1, line 6-11). It is noted that Subramanion may implicitly disclose using a fluorinated resist coating in order to be compatible with FLARE fluoropolymer ARC (column 4, line 47-61).

In light of the fact that the involved references are preparing the same or similar type of fluorinated film deposition or coating for photoresist application, one having ordinary skill in the art would therefore have found it obvious to **add a bottom antireflective fluorinated coating** such as **FLARE 2.0™** and the like fluoropolymer as taught by Subramanion. By this modification, one would expect to obtain a photoresist semiconductor device sensitive to radiation in the deep ultraviolet for patterning. Additionally, by adding a FLARE fluoropolymer ARC bottom coating, it is expected to be compatible with a fluorinated resist top coating since they are both fluorinated. Thereby a better and more diversified photoresist product can be obtained.

10. Regarding **Claim 2**, FLARE is a poly(arylene ether), which is a polymeric product made from condensation polymerization of two monomers such as Bis-phenol-A and biphenyl (at least one is fluorinated).

Regarding **Claims 11 and 16-18**, Subramanion may have taught all the requirements of Claims 16-18 in order to prepare the bottom antireflective coated (ARC) layer from FLARE 2.0™. The process may involve spin coating FLARE fluoropolymer's solution onto a semiconductor substrate and then was baked to dry as known in the art (column 8, line 51-55). Nitrogen atmosphere drying is not disclosed as a required condition.

Regarding **Claim 19**, the thickness of ARC film after drying is kept at 6000 Angstroms (which is **60 nm** by conversion) (column 7, line 9-11). Regarding **Claim 20**, Subramanion teaches that the wavelength of the exposure light or radiation on photoresist can be **248 nm** (column 7, line 7-9).

11. Claims 3-4 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Subramanion et al. (US 5,986,344) in view of Matsuo et al. (US 5,510,406).

The discussion of the disclosures of the prior art of Subramanion for Claims 2, 11 and 15-20 of this office action is incorporated here by reference. Regarding **Claims 3-4 and 7**, Subramanion is **silent on the fluoropolymer about two things as (A) comprising the claimed**

monomeric unit(s) (Claims 3 and 4), **and (B) the crosslinkable feature** in the polymer (Claim 7). **Matsuo** et al. teach the fluoropolymers can be made from both requirements (A) and (B) (see **monomers** at column 1, line 56 – column 5, line 13; see **crosslinkable monomer** at column 5, line 36 – column 7, line 3). By doing so, an advantage is to obtain a crosslinked fluoropolymer having a high fluorine content, a low refractive index and a high transparency, which are particularly useful as a cladding material for optical fiber without peeling off from core material (column 11, line 40-45).

In light of the fact that the involved references are preparing the same or similar type of fluorinated film deposition or coating for optical application, one having ordinary skill in the art would therefore have found it obvious to replace or modify Subramanion's anti-reflective fluorinated polymer by using the same crosslinkable polymer or adding the same crosslinkable monomeric unit for copolymerization as taught by Matsuo. By replacement or modification on fluoropolymer, one would expect to obtain an anti-reflective coating with a high fluorine content, a low refractive index and a high transparency **without peeling off from substrate or core material**. Thereby a better and more diversified photoresist product can be obtained.

12. Claims 3-4 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Padmanaban et al. (US 6,365,322 B1) in view of Subramanion et al. (US 5,986,344) as applied to Claims 2, 11 and 15-20, and further in view of Matsuo et al. (US 5,510,406).

The discussion of the disclosures of the prior art of Padmanaban/Subramanion for Claims 2, 11 and 15-20 of this office action is incorporated here by reference. Regarding **Claims 3-4 and 7**, Padmanaban/Subramanion is **silent on the fluoropolymer about two things as (A) comprising the claimed monomeric unit(s)** (Claims 3 and 4), **and (B) the crosslinkable feature** in the polymer (Claim 7). **Matsuo** et al. teach the fluoropolymers can be made from both requirements (A) and (B) (see **monomers** at column 1, line 56 – column 5, line 13; see **crosslinkable monomer** at column 5, line 36 – column 7, line 3). By doing so, an advantage is to obtain a crosslinked fluoropolymer coating having a high fluorine content, a low refractive index and a high transparency, which is particularly useful as a cladding material for optical fiber without peeling off from core material (column 11, line 40-45).

In light of the fact that the involved references are preparing the same or similar type of fluorinated film deposition or coating for optical application, one having ordinary skill in the art would therefore have found it obvious to replace or modify Padmanaban/Subramanion's anti-reflective fluorinated polymer by using the same crosslinkable polymer or adding the same crosslinkable monomeric unit for copolymerization as taught by Matsuo. By replacement or modification on fluoropolymer, one would expect to obtain an anti-reflective coating with a higher content on fluorine, a low refractive index and a high transparency without peeling off from substrate or core material. Thereby a better and more diversified photoresist product can be obtained.

13. Claims 3-4 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujie et al. (US 6,303,264 B1) in view of Subramanion et al. (US 5,986,344) as applied to Claims 2, 11 and 15-20, and further in view of Matsuo et al. (US 5,510,406).

The discussion of the disclosures of the prior art of Fujie/Subramanion for Claims 2, 11 and 15-20 of this office action is incorporated here by reference. Regarding **Claims 3-4 and 7**, Fujie/Subramanion is **silent on the fluoropolymer about two things as (A) comprising the claimed monomeric unit(s)** (Claims 3 and 4), **and (B) the crosslinkable feature** in the polymer (Claim 7). **Matsuo** et al. teach the fluoropolymers can be made from both requirements (A) and (B) (see **monomers** at column 1, line 56 – column 5, line 13; see **crosslinkable monomer** at column 5, line 36 – column 7, line 3). By doing so, an advantage is to obtain a crosslinked fluoropolymer coating having a high fluorine content, a low refractive index and a high transparency, which is particularly useful as a cladding material for optical fiber without peeling off from core material (column 11, line 40-45).

In light of the fact that the involved references are preparing the same or similar type of fluorinated film deposition or coating for optical application, one having ordinary skill in the art would therefore have found it obvious to replace or modify Fujie/Subramanion's anti-reflective fluorinated polymer by using the same crosslinkable polymer or adding the same crosslinkable monomeric unit for copolymerization as taught by Matsuo. By replacement or modification on fluoropolymer, one would expect to obtain an anti-reflective coating with a higher content on

fluorine, a low refractive index and a high transparency without peeling off from substrate or core material. Thereby a better and more diversified photoresist product can be obtained.

Conclusion

14. Any inquiry concerning this communication or earlier communication from the examiner should be directed to Dr. Henry S. Hu whose telephone number is **(571) 272-1103**. The examiner can be reached on Monday through Friday from 9:00 AM –5:00 PM. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Wu, can be reached on (571) 272-1114. The fax number for the organization where this application or proceeding is assigned is (703) 872-9306 for all regular communications. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Henry S. Hu

Patent Examiner, Art Unit 1713, USPTO

September 9, 2005

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